REMARKS

Entry of the above amendment is respectfully requested.

Respectfully submitted,

Aimee E. McVady
Registration No. 48,720

PIPER RUDNICK
P.O. Box 64807
Chicago, Illinois 60440-0807
Telephone: (312) 368-8167
March 27, 2003

CLAIMS

1. Fastener delivery apparatus for a fastener setting tool comprising a package pre-loaded with fasteners, at least one fastener delivery tube for interconnecting the setting tool to a fastener feeder device that releases selected fasteners from the package into the delivery tube, the fasteners being transportable individually or in groups in the tube from the feeder device to the tool, a transfer station attached to the tool or the delivery tube for transferring a fastener from the delivery tube into the tool, wherein the transfer station is moveable between a first position in which an exit of the transfer station is adjacent to the tool so that a delivered fastener may be inserted by the transfer station into the tool and a second position in which it is clear of the tool so as to permit the tool or a portion thereof to move towards a workpiece to insert a loaded fastener.

2. Fastener delivery apparatus according to claim 1, wherein there is provided an intermediate buffer for fasteners at or proximate to the transfer station tool so that multiple fasteners may be held at the transfer station.

3. Fastener delivery apparatus according to claim 2, wherein the delivery tube is releasably connectable to said intermediate buffer by an automatic docking device.

4. Fastener delivery apparatus according to claim 3, wherein the docking device comprises a first portion connected to an outlet end of the delivery tube and a second portion connected to an inlet end of the intermediate buffer, the first and second portions being moveable relative to each other to engage and provide a fastener path between the tube and the buffer, the first portion having a fastener retention gate that is closed by a biasing member when the

portions are disengaged and is opened against the force of the biasing when the portions are engaged.

5. Fastener delivery apparatus according to claim 4, wherein the fastener retention gate comprises a pair of retaining fingers, the fingers at least partially blocking the fastener path when the gate is closed.

6. Fastener delivery apparatus according to claim 4 or 5, wherein the second portion comprises an inlet gate that is closed when the portions are disengaged and is open when the portions are engaged.

7. Fastener delivery apparatus according to claim 6, wherein the inlet gate comprises a pair of laterally moveable jaws that in the closed position at least partially block the fastener path and in the open position are moved laterally clear of the fastener path by abutment with the fastener retention gate.

8. Fastener delivery apparatus according to any preceding claim wherein the transfer station is moveable relative to the setter tool by means of an actuator.

9. Fastener delivery apparatus according to claim 8, wherein the actuator operates to pivot the transfer station relative to the setting tool and to hold it against the tool.

10. Fastener delivery apparatus according to claim 9, wherein the transfer station also moves in a linear path relative to the setting tool.

11. Fastener delivery apparatus according to any preceding claim, wherein the transfer station has a cammed surface for abutment with a cam follower portion of the setting tool and, in use, movement of the transfer station relative

to the setting tool is governed by interaction of the cammed surface with the cam follower.

12. Fastener delivery apparatus according to claim 11, wherein the transfer station is mounted on a frame that is pivotally connected to the setting tool, the frame being extensible so as to move the transfer station in a direction substantially parallel to the direction of extension of a nose of the setting tool.

13. Fastener delivery apparatus according to claim 12, wherein said frame also supports a portion of said delivery tube.

14. Fastener delivery apparatus according to any preceding claim, wherein the transfer station operates to load a fastener through side port in a nose of the setting tool.

15. Fastener delivery apparatus according to claim 14, wherein the transfer station further comprises an automatic pusher assembly that is actuable to push a fastener from the station into the nose.

16. Fastener delivery apparatus according to claim 15, wherein the pusher assembly comprises at least one pusher member for pushing a leading fastener in the transfer station towards an outlet of the station and a gate disposed at the outlet and which is biased closed so as to close at least partially the outlet and to retain the leading fastener at the outlet until the fastener is pushed therethrough by the pusher member.

17. Fastener delivery apparatus according to claim 16, wherein the transfer station further comprises a fastener transport channel in which fasteners are transported to the outlet, the pusher member being moveable between a retracted position in which it is clear of the channel and an extended position

in which it projects into the channel and engages the leading fastener and pushes it through the gate and the outlet, the pusher member being disposed such that when moving between the retracted and extended positions its path does not intersect with subsequent fasteners disposed behind the leading fastener.

18. Fastener delivery apparatus according to claim 16, wherein the transfer station further comprises a fastener transport channel in which fasteners are transported to the outlet, the pusher member being moveable between a retracted position in which it is clear of the channel and an extended position in which it projects into the channel and engages the leading fastener and pushes it through the gate and the outlet, wherein the channel has a tortuous passage ending in a final section adjacent the outlet sufficient to retain only a single fastener, the path of the pusher member between the retracted and extended positions intersecting the final section such that when extended the pusher member moves only the leading rivet occupying the final section through the gate.

19. Fastener delivery apparatus according to any one of claims 1 to 13, wherein the transfer station operates to load a fastener into engagement with an end of a nose or punch of the setting tool.

20. Fastener delivery apparatus according to claim 19, wherein the transfer station comprises a channel for transporting rivets to an outlet for transfer to the nose or punch of the setting tool and sliding cover member that is slidable between an at rest position in which the channel is substantially covered and a retracted position in which a leading portion of the channel adjacent the outlet is exposed so as to provide access to a leading fastener in the channel for said nose or punch.

21. Fastener delivery apparatus according to claim 20, wherein the cover member is biased by a biasing member to the at-rest position and is moved against said biasing force by the nose or punch, such that when in the retracted position the nose or punch is aligned with the outlet so as to receive said leading fastener.

22. Fastener delivery apparatus according to claim 21, wherein the nose or punch engages with a leading edge of the cover member to effect movement of the cover against the biasing force of the biasing member.

23. Fastener delivery apparatus according to claim 22, wherein the travel of the cover member is limited by means of an adjustable stop.

24. Fastener delivery apparatus according to claim 22, wherein the cover member has a ramped surface that interacts with a complementary ramped surface on an adjacent wedge member such that movement of the cover member towards the retracted position causes movement of the wedge member in a different plane, the travel of the wedge member being limited by said adjustable stop.

25. Fastener delivery apparatus according to any one of claims 20 to 24, wherein the cover member has a separator member that is moved into a position in which it projects into said channel so as to separate said leading portion of the channel from the remainder.

26. Fastener delivery apparatus according to claim 25, wherein the separator member rides in slot defined in the cover member.

27. Fastener delivery apparatus according to any preceding claim, the fastener delivery tube having an internal passage through which fasteners may pass and at least one wear resistant strip that projects into the passage to contact the fastener.

28. Fastener delivery apparatus according to any preceding claim, the fastener package comprising a plurality of sealed channels containing fasteners, the channels being interconnected by a flexible web.

29. Fastener delivery apparatus according to claim 28, the fastener feeder device comprising means for opening at least one channel of said fastener package so as to release the fasteners into said delivery tube.

30. Fastener delivery apparatus according to claim 29, wherein the feeder device further comprises a blade for severing said at least one channel.

31. Fastener delivery apparatus according to claim 29, wherein the fastener package comprises a tube in said channel, the tube having an integral closure member for retaining fasteners in said tube, the closure member being openable by engagement with a release member of the fastener feeder device.

32. Fastener delivery apparatus according to any preceding claim, the fastener package comprising a plurality of closed tubes container fastener, the tubes being housed in a support container, the fastener feeder device comprising a conveyor on which the container is disposed and a release mechanism that passes through the conveyor to open at least one of said tubes to release said fasteners into a delivery tube.

33. Fastener delivery apparatus according to claim 32, wherein the tube has a closure member that is openable by engagement with a tube release mechanism.

34. Fastener delivery apparatus according to claim 33, wherein the release mechanism is moveable laterally of the conveyor.

35. Fastener delivery apparatus according to claim 1, wherein said feeder device comprises a support on which are mounted a plurality of containers each containing fasteners in vertical array, and a release mechanism that is moveable relative to an underside of the support, the release mechanism comprising a carriage captively fitted to the support and a chamber for receiving at least one fastener from a container, an actuator for directing the fastener out of the carriage into a delivery tube and release means for releasing a fastener from the container, characterised in that the release mechanism further comprises a guide element that engages a complementary guide element on the support so that its movement under the support is along a predetermined path.

36. Fastener delivery apparatus according to claim 1, wherein said feeder device comprises a hopper having at least one aperture into which a sealed container of fasteners is releasably secured, a gate which is moveable relative to the hopper between positions which open and close the aperture and a reservoir into which released fasteners are dispensed, wherein the container has a frangible seal that is broken when the feeder device is satisfied that the contents are correct so as to release the fasteners, the gate moving to the open position to pass the fasteners to the reservoir.

37. Fastener delivery apparatus according to any preceding claim wherein said delivery tube comprises a first portion of T-shaped cross-section and a second portion of circular cross-section and an intermediate interface tube with an internal configuration that rotates the fastener so that it can move between the first and second portions.

38. Fastener delivery apparatus according to claim 37, wherein the interface tube has a ledge disposed above a cavity, the ledge having a slot through which a

stem of the fastener may drop such that, in use, a head of the fastener is supported on the ledge and the fastener rotates about its head such that the stem of the fastener drops into said cavity via the slot.

39. Fastener delivery apparatus according to any preceding claim, wherein there is provided a fastener escapement device having a moveable surface that projects through an aperture provided in the delivery tube so as, in use, to trap at least one fastener in the delivery tube, the escapement device further comprising a drive for selectively indexing said surface so as, in use, to move the at least one fastener in the delivery tube towards a release position.

40. Fastener delivery apparatus according to claim 39, wherein the escapement device further comprises a sensor at the release position for sensing the presence of a fastener, the sensor being associated with a counter for counting the number of fasteners that pass the release position.

41. Fastener delivery apparatus according to claim 39 or 40, wherein the surface is defined on a continuous endless loop conveyer.

42. Fastener delivery apparatus according to any preceding claim, wherein the delivery tube has a bend, the bend dividing the tube into incoming and outgoing portions, a transverse aperture in said incoming portion for connection to a source of pressurised fluid and a fluid recirculation chamber substantially opposite said aperture for redirecting incoming fluid into said outgoing portion such that, in use, said fluid passing through the aperture is incident on fasteners in the incoming portion so as to retain them there and is redirected in said recirculation chamber so as to be incident on the lead rivet at the bend and to propel it into the outgoing portion.

43. Fastener delivery apparatus according to claim 42, wherein there is provided a further transverse aperture upstream in said incoming portion.

44. Fastener delivery apparatus according to any preceding claim, wherein there is provided at least two delivery tubes that merge at an intersection into a single outlet tube, a pivotal gate disposed at the intersection selectively closing one of the delivery tubes.

45. Fastener delivery apparatus according to claim 44, wherein the gate is movable between a first position in which it closes a first incoming delivery tube so as to leave a clear path between a second incoming delivery tube and an outlet tube.

46. Fastener delivery apparatus according to any preceding claim, wherein the transfer station is connected to at least two delivery tubes and a rotary gate is disposed at an intersection of the tubes, the gate being moveable between a first position in which it blocks a first of the delivery tubes and leaves clear a path between a second of delivery tubes and an outlet of the transfer station and a second position in which it blocks the second of the delivery tubes and leaves clear a path between a first of the delivery tubes and the outlet.

47. Fastener delivery apparatus according to claim 46, wherein the gate has a channel therein to allow communication between a selected one of the delivery tubes and the outlet.

48. A fastener feeder assembly for a fastener delivery apparatus comprising a hopper having at least one aperture into which a sealed container of fasteners is releasably secured, a gate which is moveable relative to the hopper between positions which open and close the aperture and a reservoir into which

released fasteners are dispensed, wherein the container has a frangible seal that is broken when the feeder device is satisfied that the contents are correct so as to release the fasteners, the gate moving to the open position to pass the fasteners to the reservoir.

49. A fastener feeder assembly according to claim 46, wherein the container has a plurality of notches that identify the contents and a checking device is provided to detect the presence of the notches to ensure the contents of the container are correct.

50. A fastener feeder assembly according to claim 45 or 46, wherein the gate is rotatable relative to the hopper between the open and closed positions.

51. A fastener feeder assembly according to claims 45, 46, or 47, wherein the container has a lip by which it is releasably securable under an edge of the aperture.

52. A fastener feeder assembly for a fastening delivery apparatus comprising a support on which are mounted a plurality of containers each containing fasteners in vertical array, and a release mechanism that is moveable relative to an underside of the support, the release mechanism comprising a carriage captively fitted to the support and release means for releasing a fastener from the container into a delivery tube characterised in that the release mechanism further comprises a guide element that engages a complementary guide element on the support so that its movement under the support is along a predetermined path.

53. A fastener feeder assembly according to claims 52, wherein the fasteners are released from the container into the carriage under gravity.

54. A fastener feeder assembly according to claim 52 or 53, wherein the release means is a pusher arm that pushes the released fastener to a position adjacent an exit aperture.

55. A fastener feeder assembly according to any one of claims 52 to 53, wherein the support is inclined to the horizontal so that the carriage is moveable in at least one direction under gravity.

56. A fastener feeder assembly according to claim 52, wherein the fasteners are housed in a plurality of closed tubes, each tube having a closure member that is openable by the release means to release the fasteners.

57. A fastener feeder assembly according to claim 56, wherein the release means is a projecting member that deflects the closure member of the tube.

58. A fastener feeder assembly for fastener delivery apparatus comprising a fastener package in the form of a plurality of sealed channels containing fasteners, the channels being interconnected by a flexible web, a release device for opening a selected channel so as to release the fasteners and an outlet for connection to a delivery tube of the delivery apparatus.

59. A fastener feeder assembly according to claim 58, wherein the package is of continuous and elongate length.

60. A fastener feeder assembly according to claim 58 or 59, wherein package is indexed past the release device on a rotary wheel having a plurality of radial pockets spaced about its periphery the channels of the package being received in said pockets.

61. A fastener feeder assembly according to any one of claims 58 to 60, wherein the release device is a cutting member for severing a selected channel of said package.

62. A fastener feeder assembly according to any one of claims 58 to 60, wherein the fastener package comprises a tube in said channel, the tube having an integral closure member for retaining fasteners in said tube, the closure member being openable by engagement with the release member.

63. A fastener feeder assembly according to claim 58 or 59, further comprising a rotary slotted drum over which the package is wound, the release device being a cutting member radially moveable into a slot to sever a least one selected channel of the package and release the fasteners from a selected channel.

64. A fastener delivery tube for interconnecting a setting tool to a source of fasteners, the tube having an internal passage through which fasteners may pass and at least one wear resistant strip that projects into the passage to contact the fastener.

65. A fastener delivery tube according to claim 64, wherein the wear resistant strip is releasably secured to a wall of the tube.

66. A fastener delivery tube according to claim 64 or 65, wherein the walls of the tube are separable and interchangeable.

67. A fastener delivery tube according to any one of claims 64, 65 or 66, comprising two portions that are interconnected by a hinge, so that the tube can be hingedly opened to expose the passage.

68. A fastener delivery tube according to any one of claims 64 to 66, wherein the tube comprises two separable portions that each have at least one flange, flanges of the two portions being secured together by a releasable fastener.

69. A fastener delivery tube according to claim 68, wherein the releasable fastener forms part of a support frame in which the tube is supported.

70. A fastener delivery tube according to any one of claims 64 to 69, wherein the delivery tube has a second passage in which service cables are housed.

71. A fastener delivery tube according to any one of claims 64 to 70 wherein tube is elongate and flexible.

72. A fastener delivery tube for interconnecting a setting tool to a source of fasteners, the tube comprising an internal passage through which fasteners may pass, a first portion of T-shaped cross-section, a second portion of circular cross-section and an intermediate interface tube with an internal configuration that rotates the fastener so that it can move between the first and second portions.

73. A fastener delivery tube according to claim 72, wherein the interface tube has a ledge disposed above a cavity, the ledge having a slot through which a stem of the fastener may drop such that, in use, a head of the fastener is supported on the ledge and the fastener rotates about its head such that the stem of the fastener drops into said cavity via the slot.

74. Fastener delivery apparatus according to any one of claims 1 to 47, wherein at least one delivery tube comprises at least first and second inlet branches connected to a single outlet branch, and a gate being disposed between the

inlet and outlet and being operable to close communication between one of the inlet branches and the outlet branch.

75. Fastener delivery apparatus according to claim 74, wherein the gate is pivotally mounted in the tube and is operable to close communication between the first inlet and the outlet branch by being struck by a fastener travelling along a second inlet branch.

76. Fastener delivery apparatus according to any one of claims 1 to 47, wherein the transfer station has a rotation device for rotating the fastener through substantially a right angle so that it is correctly oriented for entry into a fastener delivery passage of the setting tool, the rotation device comprising a carriage that is moveable along a transfer path toward the fastener delivery passage and is designed to receive a fastener from the delivery tube, a cam surface that causes the carriage to rotate through a right angle as it moves align the transfer path, and a plunger for moving the rotated fastener out of the carriage into the fastener delivery passage.

77. Fastener delivery apparatus according to claim 76, wherein the carriage further comprises a fastener support pivotally mounted on a pivot member that is moveable in a slot defined along the transfer path.

78. Fastener delivery apparatus according to claim 77, wherein the cam surface is defined on an interference block disposed in the transfer path of the carriage such that the pivot member rotate when it slides over the surface.

79. Fastener delivery apparatus according to claim 78, wherein the carriage further comprises a rotary element having a helical cam surface that moves over a fixed pin on the transfer station so that axial movement of the carriage also causes it to rotate.

ABSTRACT

Fastener delivery apparatus for automatically selecting and delivering fasteners such as rivets to a setting tool. The fasteners are pre-loaded in a package and dispense via at least one fastener delivery tube that interconnects the setting tool to a fastener feeder device. The fastener feeder device releases selected fasteners from the package into the delivery tube. The fasteners are transportable individually or in groups in the tube from the feeder device to the tool. A transfer station attached to the tool or the delivery tube transfers a fastener from the delivery apparatus into the tool, the transfer station being moveable between a first position in which an exit of the transfer station is adjacent to the tool so that a delivered fastener may be inserted by the transfer station into the tool and a second position in which it is clear of the tool so as to permit the tool or a portion thereof to move towards a workpiece to insert a loaded fastener. The delivery tube has wear resistant elements. The apparatus allows smooth, rapid and reliable delivery of fasteners of various sizes and types to the nose of a setting tool in any particular order and provides all the fastener types for any particular work cycle.